

# Measuring Financial Performance in Infrastructure: An Application to Europe and Central Asia

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## Abstract

Unintentional implicit subsidies (hidden costs) to public utilities can be considered an illegitimate claim on public resources. This paper examines the role and sources of hidden costs in the energy and water sectors in the Europe and Central Asia region (ECA). It reviews available data and introduces a model—the Hidden Costs Calculator that can be used to quantify the burden on governments of infrastructure policy and implementation decisions. This simple-to-apply model provides insight into three key components of hidden costs that affect infrastructure—poor bill collection rates, excessive losses due to inefficient operations or theft from the networks, and tariffs set below cost-recovery rates. The major advantage of this model is that, using existing data, it can provide a single measure for hidden costs that can be easily calculated, tracked, and reported; therefore it can monitor and benchmark trends across sectors and countries without extensive or costly data collection. The model compares the difference between actual revenues and revenues that could be anticipated in a well-functioning system operating with cost-covering tariffs, bills paid, and losses normative for networks of a certain age and design. The underlying premise is that quantifying the order of magnitude of each component of hidden costs has potential for strengthening infrastructure policy dialogue and influencing decision makers who allocate scarce budgetary resources.

**Keywords:** Infrastructure, utilities, finance, hidden costs, subsidies

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**Infrastructure Department  
Europe and Central Asia Region (ECA)  
The World Bank**

## Abbreviations and Acronyms

%	Percent
ACRP	Average cost recovery price
Bank	The World Bank
CEE	Central and Eastern Europe
CIS	Commonwealth of Independent States
Cu.m	Cubic Meter
EAP	East Asia Pacific Region
ECA	Europe and Central Asia
ECSIE	Infrastructure Unit, ECA Region, The World Bank
EU	European Union
FSU	Former Soviet Union
FSU-LI	FSU low income countries
FSU-MI	FSU middle income countries
FY	Financial Year
GDP	Gross Domestic Product
ISPA	Instrument for Structural Policies for Pre-Accession
Km	Kilometers
KWh	Kilo watt hours
LI	Low Income
Mcm	Thousand cubic meters
MWh	Mega watt hours
OECD	Organization for Economic Cooperation and Development
US\$	United States dollars
USc	United States cents
USSR	Union of Soviet Socialist Republics
Veh.	Vehicle
WAET	Weighted Average End User Tariff

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## **Acknowledgements**

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## **Introduction**

Reliable and affordable infrastructure is essential for a well-functioning economy. Today in Europe and Central Asia (ECA) underperforming public utilities impede more rapid economic growth. This working paper raises a constellation of issues—high losses, non-payment of bills, and tariffs set below cost-recovery rates—that block progress in the power, natural gas, and water sectors. The paper reviews available data on these sectors and begins to develop a model to quantify the burden on national budgets of infrastructure policy and implementation decisions. The intention is to widen opportunities for overall improvements in allocating scarce budgetary resources by offering policymakers data that will be useful to (a) understand the order of magnitude of current hidden fiscal costs, (b) estimate the costs of current and future policy choices, (c) and reduce the burden on consumers.

Implicit subsidies to public utilities can be considered an illegitimate claim on public resources. Direct subsidies to utilities are formally allocated and formally recorded ‘on the books.’ For a discussion of implicit subsidies and their impact on the quasi fiscal deficit, see Saavalainen and Ten Berge (2004). In contrast, ‘hidden’ costs, although accumulated by utilities, go unrecorded, thereby creating a fiscal burden on the local or national government that amounts to a hidden subsidy. Typically utilities compensate for these hidden costs by reducing investment in maintaining the utility; they may also delay or forego essential maintenance and repairs or reduce the workforce, actions that trigger a downward spiral of significant deterioration in the value of assets, declining service quality, and increasing cost for each unit of service provided. When this happens, losses are increased substantially and abnormally high investment is required to carry out repairs, which is rarely cost effective.

## **The Cost of Policy Choices**

The vicious cycle—that begins with hidden costs and proceeds to hidden subsidies—means that when governments finally absorb accumulated debts, they do so at the cost of adding to the national debt or reducing funding for other programs. This cycle has persisted in part because of difficulties in quantifying the order of magnitude of ‘hidden costs.’ The Hidden Costs Calculator model—developed through collaboration between the World Bank Group and the International Monetary Fund (Saavalainen and Ten Berge, 2006)—was designed to provide a single measure for all implicit subsidies so that policymakers can weigh the price of policy actions (or inactions) that could, but do not, have a fiscal offset. One important criterion for developing the model was to calibrate carefully the tradeoffs between complexity and comprehensiveness on the one hand and ease of use on the other. The major advantage of this model is that—using existing data—it can provide a single measure for hidden costs that can be easily calculated, tracked, and reported; therefore it can monitor and benchmark trends across sectors and countries without extensive or costly data collection.

## **The Hidden Costs Calculator Model**

The model, the Hidden Costs Calculator, is designed to provide insight into three key components of hidden costs affecting ECA infrastructure: poor bill collection rates; excessive losses due to inefficient operations or theft from the network in power, gas or water systems; and tariffs set below cost-recovery rates (i.e., amounts needed for long-run operations and maintenance, investment, and normative losses). This model compares the difference between actual revenues and revenues that could be anticipated in a well-functioning system operating with cost-covering tariffs, bills paid, and losses normative for networks of a certain age and design.

In its final form the applied model to estimate hidden costs, H is expressed as:

$$H = R^* - R$$

where  $R^*$  is the expected revenue and  $R$  is the actual revenue.  $H$  can be expressed alternatively as a function of tariffs below cost recovery, unaccounted losses and poor collections, by substituting for these variables:

$$H = Q_e (T_c - T_e) + Q_e T_c (l_m - l_n) / (1 - l_m) + Q_e T_e (1 - R_{ct})$$

where,

$Q_e$  = end user consumption

$T_c$  = average cost-recovery price

$T_e$  = weighted average end user tariff

$l_m$  = total loss rate

$l_n$  = normative loss rate

$R_{ct}$  = collection rate

See Annex 1 for a full derivation.

Note that tariffs set below cost-recovery levels as a recognized policy should be considered an explicit subsidy and therefore should be deducted from the overall calculation. In this case the correct measure of hidden costs would be as follows:

$$H = R^* - R - T$$

where  $T$  is the amount of capital or other transfer. No attempt has been made to estimate  $T$  in this paper and hidden costs may in some cases be overestimated.

## **Data Used in the Hidden Costs Calculator**

Hidden costs estimates in the energy sector span 22 ECA countries. However due to decentralization of water service provision, coverage in this paper is limited to the 16 countries with available data. Data collection has focused on 2000 to 2003 using internationally known sources or existing data collection instruments where possible. Since there are no external datasets of desired financial performance (e.g., average cost-recovery price), supplemental data have been applied (from existing World Bank Group publications and reports; from World Bank Group and International Monetary Fund sector specialists). The paper presents information reported in external datasets or by utilities that have been checked for inconsistencies and outliers but no special audit has been conducted. Specific assumptions that may be used in place of sector specific data, including normative loss rates and average cost recovery prices, are presented in Annex 1. All data presented in this paper are in 2001 constant US dollars to eliminate trends or fluctuations that result from currency conversions.

## **Key Findings: Hidden Costs in the ECA Region are Significant**

Throughout the region during this period, the power sector's share of hidden costs has been the largest. The water sector and gas sector contributions are of similar magnitude to each other but their combined impact is still less than that of the power sector. Tariffs set below the cost-recovery rates is the single most significant factor in the energy sector—power and gas while unaccounted losses are the main factor in the water sector.

Hidden costs in the power sector averaged 4.4 percent of gross domestic product (GDP) in 2003, down from double that figure in 2000. About half of this decline is due to an increase in GDP, but the remainder is attributed to improved sector performance. Since 2000, hidden costs in the gas and water sectors have changed little—2002 estimates were 1.0 percent of GDP for gas and 1.2 percent for water. Such minor movement in region-wide hidden cost estimates for the gas and water sectors makes trend analysis difficult. However, applying the model to national datasets frequently makes it possible to discern country-wide trends.

### ***Power Sector***

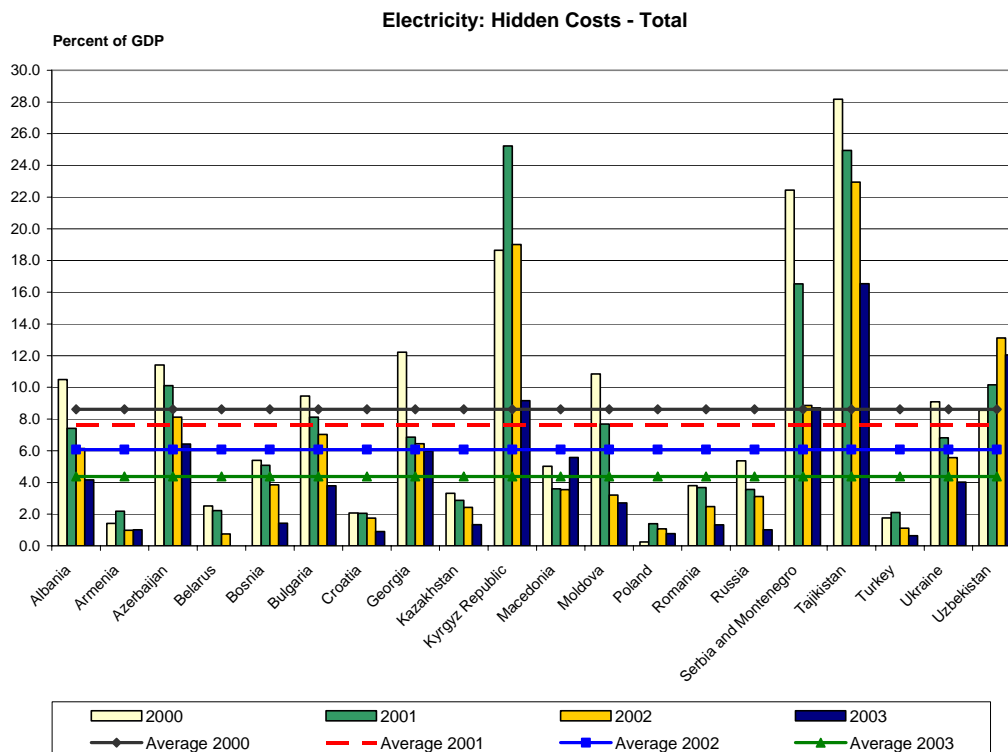
Throughout the region, tariffs set below cost-recovery rates accounted for 67 percent of aggregate hidden costs in 2003, followed by unaccounted losses at 22 percent, and poor collections at 11 percent. Overall, the aggregate value of total hidden costs declined by about 48 percent from a value of US\$ 30.1 billion in 2000 to US\$ 15.9 billion in 2003.<sup>1</sup> The largest declines were in Russia (70 percent, from US\$ 14.2 billion in 2000 to US\$ 4.2 billion in 2003) and Bosnia (62 percent, from US\$ 251.5 million to US\$ 96 million). Notably, two countries with high hidden costs that differ from other countries by a wide margin are Tajikistan at 16 percent of GDP and Uzbekistan at 12 percent.

- *Tariffs and cost-recovery rates.* In absolute terms the contribution to overall hidden costs due to tariffs set below cost recovery totaled US\$10.6 billion in 2003. In relative terms, these costs have declined from 5.4 percent of GDP in 2000 to 2.6 percent GDP in 2003, despite increasing consumption across the region. Two factors contributed to this decline—GDP increased and the gap narrowed between the average cost-recovery price and the weighted average end user tariff. In Turkey tariffs exceeded cost-recovery levels in 2003, and in Moldova, 2002, eliminating this form of hidden cost. Over the same period in Croatia cost-recovery levels and weighted-average tariffs converged significantly. In 2003 high hidden costs persisted, due to tariffs set below cost-recovery levels, in Tajikistan—14 percent of GDP, and Moldova—8.0 percent.
- *Unaccounted Losses.* Region-wide, hidden costs due to unaccounted losses initially increased from 2.0 percent of GDP in 2000 to 2.2 percent in 2001, but then steadily declined to 1.1 percent in 2003.<sup>2</sup> During 2003, hidden costs due to unaccounted losses were highest in Former Soviet Union (FSU)-Low Income (LI) countries—Kyrgyz Republic (4.5 percent of GDP), Georgia (3.3 percent), Moldova (3.2 percent) and Armenia (2.2 percent). Total losses in these countries were in excess of 26 percent of domestic supply. In all other countries unaccounted losses comprised less than 2.0 percent of GDP where total losses ranged between 10 and 20 percent of domestic supply. The largest decline in unaccounted losses (as a proportion of GDP) occurred in Belarus and Bosnia—each more than 100 percent. There was a corresponding decline in total losses in Bosnia.

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<sup>1</sup> Excluding Hungary and Turkmenistan for which no data were available.

<sup>2</sup> Excluding Hungary and Turkmenistan—no data available.



## Natural Gas Sector

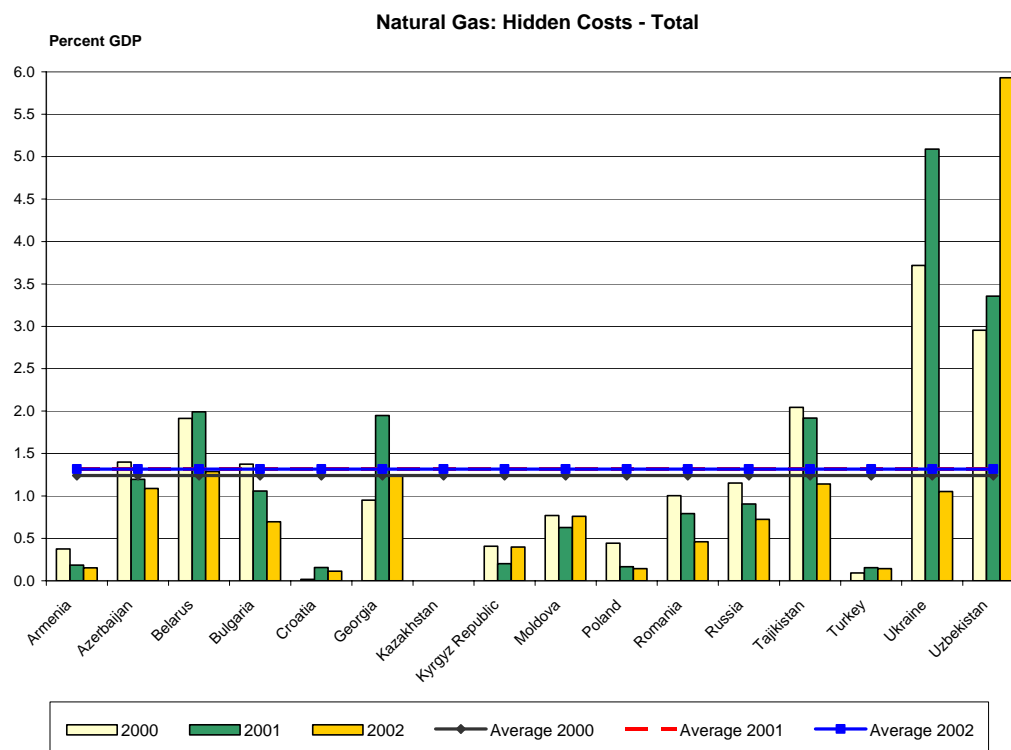
Across the Region tariffs set below cost-recovery levels accounted for 70 percent of total hidden costs, collection failures at 29 percent, and unaccounted losses at 1.0 percent. Hidden costs for natural gas remained below 2.0 percent of GDP for all years and in all countries except Ukraine (in earlier years) and Uzbekistan, where they were between 3.0 and 6.0 percent. Overall in the Region hidden costs declined from US\$ 6.6 billion in 2000 to US\$ 4.7 billion in 2002. In absolute values, Ukraine had the largest decrease in the three years prior to 2002 (a drop of US\$ 749 million); in relative terms Poland had the largest decline—64 percent in the same three years.

- *Natural gas tariffs and cost recovery.* Region-wide, in relative terms, hidden costs due to tariffs set below cost recovery declined from 0.8 percent to 0.6 percent of GDP, despite a 13 percent increase in end-user consumption for the period ending in 2002. This shows a convergence between average cost-recovery prices and weighted average end-user tariffs. In constant 2001 US\$, hidden costs from tariffs set below cost-recovery levels declined 35 percent—from US\$ 5.1 billion in 2000 to US\$ 3.3 billion in 2002. The largest decline in hidden costs occurred in Central and Eastern European (CEE) countries. Azerbaijan, Belarus, Kyrgyz Republic, and Uzbekistan increased over this period.
- *Natural gas—collection rates.* During 2000-02, hidden costs due to collection failures remained largely unchanged at around 0.4 percent of GDP, roughly US\$ 90 million. This is consistent with relatively small changes in collection efficiency. Other than Tajikistan,<sup>3</sup> ECA countries improved their collection rates very gradually, reflecting diminishing scope for potential revenue leakages due to poor revenue collection institutions. Marked differences existed in collection rates across the Region; Georgia's rate remained low at 25 percent; Croatia, Moldova, Poland, and Turkey

<sup>3</sup> Tajikistan's collection rates for the first three years were in the 50-55 percent range, and spiked to 100 percent in 2003.



remained between 78 and 90 percent. No country for which data were available exhibited a decline in collection rates.

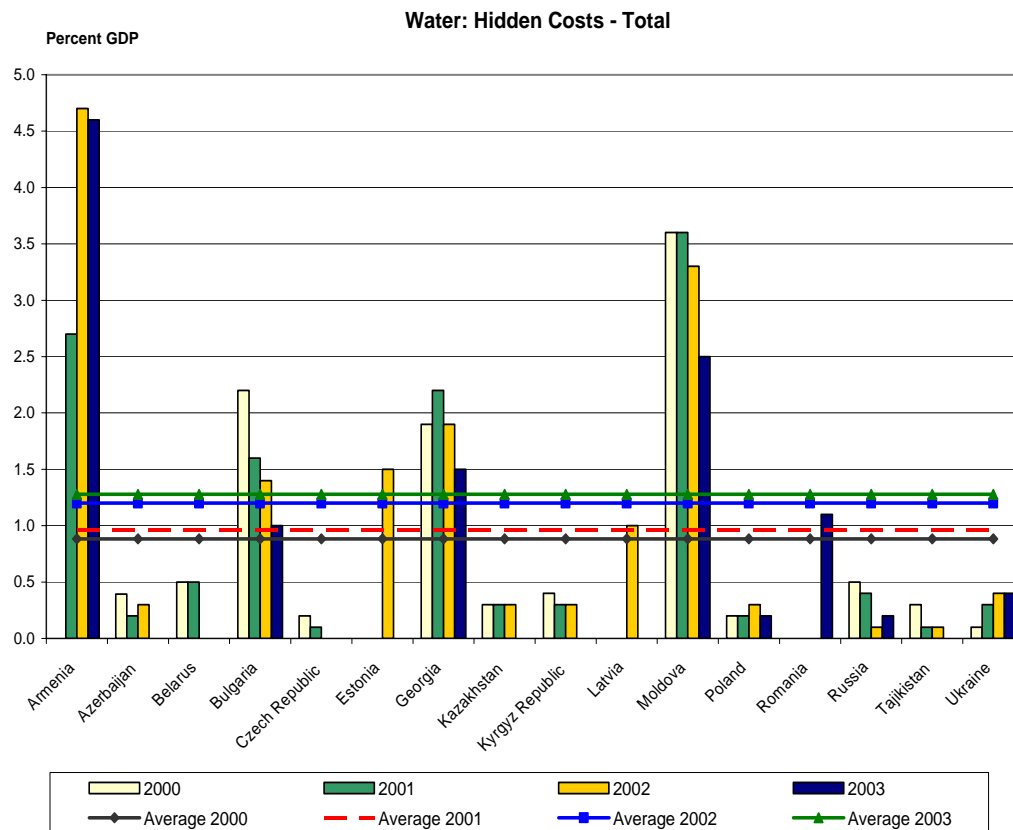


## Water Sector

During 2002, hidden costs (in absolute terms) comprised—unaccounted losses, 50 percent; tariffs set below cost, 43 percent; poor collections, 7.0 percent. Hidden costs in all countries and for all years are below 2.5 percent of GDP, except Armenia and Moldova. In relative terms, hidden costs in the region overall, as a proportion of GDP, increased from 0.9 percent in 2000 to 1.2 percent in 2002. However, the aggregate value of hidden costs in this sector declined between 2000-02 by about 30 percent, from US\$ 2.5 billion in 2000 to US\$ 1.8 billion in 2002. The largest declines in hidden costs were for Russia and Tajikistan—a decline of around 70 percent in each country in the same period.

- *Water—unaccounted losses.* Former Soviet Union countries contributed most to an increasing trend of hidden costs due to unaccounted losses, which rose from an average of 0.6 percent of GDP in 2000 to 0.9 percent in 2002; from US\$ 626 million to US\$ 939 million. This is consistent with deteriorating integrity of supply networks evidenced by a rise in total system losses (water abstracted minus water billed) from 32 percent in 2000 to 39 percent in 2002. Losses increased the most in FSU-Low Income countries, perhaps indicating deteriorating supply networks.<sup>4</sup>
- *Water—tariffs and cost recovery.* Overall hidden costs due to tariffs set below cost-recovery levels decreased 31 percent from US\$ 1.140 million to US\$ 785 million, led by FSU-Middle Income countries (55 percent over the period). However, data for 2003, while not covering all countries, showed an overall increasing trend. As a percentage of GDP this has remained on average between 0.4-0.5 percent.

<sup>4</sup> Although in absolute terms losses in Azerbaijan were the lowest across all countries.



## Going Forward

This exercise demonstrated that estimating the order of magnitude of hidden costs is worth pursuing. In the energy and water sector, the intention is to continue to update this dataset as information becomes available through external sources for additional countries for 2004 and onward. Future updates will be available through the website <http://ecadata-worldbank.org>.

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## Annex 1. Calculating Hidden Costs in the Energy and Water Sectors

### A. Model

The model to calculate “hidden costs” in the infrastructure sector is described below. While there are more detailed and complex ways in which a model could be developed to reflect a loss in specific countries and sectors, this model has been formulated specifically to provide an insight into three key components of hidden costs: poor collections, tariffs set below cost-recovery levels and losses above normative levels. The intention in developing this model was to devise a simple-to-use methodology with which to monitor trends and to benchmark across sectors and countries without the need for intensive data collection efforts.

Let H be the “hidden costs” in the (electricity, gas or water) sector, defined as:

$$H = R^* - R \dots\dots\dots (1)$$

Where,

$R^*$  is the expected revenue in a system operating with tariffs that cover costs, where bills are paid and where losses are within normal levels expected for a system of that age and design.

R is the actual revenue.

If,

$Q_s$ , is the volume (electricity, gas or water) supplied to the transmission network.

$Q_e$ , is the end-user consumption (of electricity, gas or water)

$L_m$ , are the losses in transmission and distribution (of electricity, gas or water).  $L_m$  includes normative losses,  $L_n$  where  $L_n$  are those losses that are expected in a system of that design and age as well as losses due to system inefficiencies outside norms and theft.

Then,

$$Q_s = Q_e + L_m \dots\dots\dots (2)$$

And,

$$R^* = (Q_s - L_n) T_c \dots\dots\dots (3)$$

Where  $T_c$  defined as the cost-recovery tariff, is the long run cost of operation and maintenance and includes a reasonable allowance for investment and normative losses.

And,

$$R = (Q_s - L_m) T_e R_{ct} \dots\dots\dots (4)$$

Where  $T_e$  is defined as the weighted average end-user tariff, and  $R_{ct}$  is the rate of collection of billed amounts.

Substituting for  $R^*$  and R in (1), using (3) and (4), then

$$H = (Q_s - L_n) T_c - (Q_s - L_m) T_e R_{ct}$$

$$H = (Q_e + L_m - L_n) T_c - Q_e T_e R_{ct}$$

$$H = Q_e (T_c - T_e) + (L_m - L_n) T_c - Q_e T_e (R_{ct} - 1)$$

$$H = Q_e (T_c - T_e) + T_c (L_m - L_n) + Q_e T_e (1 - R_{ct}) \dots\dots\dots (5)$$

Total losses,  $L_m$ , can also be defined as  $l_m Q_s$ , or the rate of total losses multiplied by the volume (of electricity, gas or water) supplied to the system.

Normative losses,  $L_n$ , can in turn be defined as  $l_n Q_s$ , or the rate of normative losses multiplies by the volume (of electricity, gas or water) supplied to the system.

Therefore,

$$L_m - L_n = (l_m - l_n) Q_s \dots\dots\dots (6)$$

Where  $Q_s$  is defined in (2) as:

$$Q_s = Q_e + L_m$$

Substituting for  $L_m$ , we have,

$$Q_s = Q_e + l_m Q_s$$

$$Q_s (1 - l_m) = Q_e$$

$$Q_s = Q_e / (1 - l_m) \dots\dots\dots (7)$$

Substituting for  $Q_s$  in (6) using (7) gives:

$$L_m - L_n = (l_m - l_n) Q_e / (1 - l_m) \dots\dots\dots(7)$$

Hidden costs defined in (5) can therefore be expressed as:

$$H = Q_e (T_c - T_e) + Q_e T_c (l_m - l_n) / (1 - l_m) + Q_e T_e (1 - R_{ct}) \dots\dots\dots(8)$$

In performing the calculation if any of the three components of hidden costs defined above has a value of less than or equal to zero, it is set to zero.

Please note that tariffs set below cost-recovery levels as a matter of policy are considered an explicit subsidy and should be deducted from the overall calculation. In this case the correct measure of hidden costs would be

$$H = R^* - R - T$$

Where,  $T$  is the amount of capital or other transfer. No attempt has been made to estimate  $T$  in this paper and hidden costs may in some cases be overestimated.

## **B. Applying the Model: Key Assumptions**

### ***Adjustment of Financial Data to Constant US\$ (2001)***

In all cases currency tabulations for each year have been reported in constant US\$ 2001.

Most original data were obtained in year-specific local currency units. They were converted to US\$ using the average annual exchange rate (local currency to US\$) as reported in the World Bank World Development Indicators and subsequently calibrated to constant 2001 US\$ using the US\$ deflator series also in the World Development Indicators.

While using country-specific purchasing power parity indices would have generated similar constant 2001 US\$ currency values, this option was not chosen as data were not available for purchasing power parity for all the countries and for all the periods included in the paper.

### ***a) Water Sector***

#### ***Specific Assumptions Made in Manipulating Data in the Water Sector***

In the water sector five specific assumptions have been made:

- (i) The calculation of overall hidden costs is based on municipalities and urban settlements with centralized water services where the population is above 5,000. Rural settlements have been excluded from the calculation of subsidies as there is no systematic data collection and information gathering.
- (ii) The normative level of water losses has been assumed to be 20 percent of produced water. This level is representative of developed water systems in England and Wales.<sup>5</sup>
- (iii) To enable cross-country comparisons, indicators used in the calculation of overall hidden costs have been extrapolated from per capita average values that have been available for a representative sample of utilities. In extrapolating to a national average, per capita values have been multiplied by the urban population in the country. The result is considered to be representative for the following reasons: (a) for Russia, the data set covers more than 90 municipal water and sewerage utilities in four regions of the country<sup>6</sup> serving over 7.6 million residents or 5.2 percent of total population; (b) in Ukraine the data set covers more than 60 municipal water and sewerage utilities in four oblasts<sup>7</sup> serving over 5.8 million residents or 10 percent of total population; and (c) for smaller countries the data set covers between 20 percent (for Kazakhstan) and 100 percent of the total urban population (Moldova and Armenia).
- (iv) Average water tariffs have been calculated as the cost per cubic meter actually billed to a consumer (vs. declared tariffs) using data reported by the utilities to calculate the average tariff for an entire year. This approach avoids inconsistencies due to privileges for different consumer groups in different countries and cities.

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<sup>5</sup> <http://www.wrcplc.co.uk>

<sup>6</sup> Samara oblast, Krasnodar krai, Leningrad oblast, Perm oblast, and several others from northwest Russia

<sup>7</sup> Kharkiv, Mykolayiv, Lviv, and Transcarpatia

- (v) It is assumed that all assets have a life span of 25 years to ensure service standards are maintained. While this period is short it reflects the Soviet standard that is practiced in all countries of the paper.

### ***Calculation of Average Cost Recovery Price in the Water Sector***

Cost-recovery tariffs are defined as the cost of supplying water 24 hours a day, including the cost of operation, maintenance and necessary investments. Where an average cost-recovery price has not been available the following assumptions have been made in its calculation:

$$ACRP = [Current\ cost\ of\ operation] + [24\ hours-a-day\ supply\ factor] + [Investment\ component]$$

Where:

*Current cost of operation, C* - The actual reported operation and maintenance cost collected from the OECD data set<sup>8</sup> or by using the IB-NET<sup>9</sup> toolkit.

*24 hours-a-day supply factor, T* - To reduce short-term costs, especially electricity costs, water utilities initiate intermittent water supply. Reducing operational hours results in some savings that reduce costs in the short run, but long-run costs increase dramatically due to hydraulic shocks that destroy the water infrastructure and other effects that reduce water quality. It has been assumed that savings incurred through interrupted water supplies are equal to one-quarter of the cost of maintaining supplies round the clock due to energy savings and reduced short-term maintenance. As a rule, intermittent water supply does reduce consumption.

Here,

$$T = 0.25\ C\ (1 - (t/24))$$

Where,

t = number of hours of water supply

*Investment Component, I* - Assumed to be equivalent of 4 percent of the value of the assets per year on the basis that assets have a life span of 25 years to ensure service standards are maintained. The fixed asset value is reported in IB-NET.

$$I = 0.04\ A / P$$

Where,

A = fixed asset value in US\$

P = annual water production in m<sup>3</sup>

Therefore the Average Cost Recovery Price, ACRP equals

$$ACRP = C + T + I$$

$$ACRP = C + 0.25\ C\ (1 - (t/24)) + 0.04\ A / P$$

<sup>8</sup> [www.oecd.org/document/49/0,2340,en\\_2649\\_34343\\_1839281\\_1\\_1\\_1\\_1.00.html](http://www.oecd.org/document/49/0,2340,en_2649_34343_1839281_1_1_1_1.00.html)

<sup>9</sup> <http://www.ib-net.org/>

*For example:*

The water system of the country N provides water services 12 hours a day supplying 100,000 cubic meters of water a day to its consumers. The fixed asset value is \$100 million (approximately \$100 per capita). The reported cost of water services is \$0.10 per cubic meter.

ACRP is calculated as follows:

$$C = \text{US\$ } 0.10 \text{ per m}^3$$

$$T = 0.25 \text{ US\$ } 0.10 \text{ per m}^3 (12/24) = \text{US\$ } 0.013 \text{ per m}^3$$

$$I = 0.04 \text{ US\$ } 100,000,000 / (365 \times 100,000 \text{ m}^3 \text{ per day}) = \text{US\$ } 0.109 \text{ per m}^3$$

And

$$\text{ACRP} = \text{US\$ } 0.10 \text{ per m}^3 + \text{US\$ } 0.013 \text{ per m}^3 + \text{US\$ } 0.109 \text{ per m}^3 = \text{US\$ } 0.22 \text{ per m}^3$$

### ***Thresholds Used for the Average Cost-recovery Price in the Water Sector***

Where data are not readily available to calculate the Average Cost Recovery Price the following thresholds could be applied:

	<b>Developing countries</b>	<b>Industrialized countries</b>
<US\$0.20/m <sup>3</sup>	Tariff <i>insufficient</i> to cover basic operating and maintenance costs	Tariff <i>insufficient</i> to cover basic operating and maintenance costs.
US\$0.20-0.40/m <sup>3</sup>	Tariff <i>sufficient</i> to cover operating and some maintenance costs	Tariff <i>insufficient</i> to cover basic operating and maintenance costs.
US\$0.40-1.00/m <sup>3</sup>	Tariff <i>sufficient</i> to cover operating, maintenance and most investment needs	Tariff <i>sufficient</i> to cover operating and maintenance costs
>US\$1.00/m <sup>3</sup>	Tariff <i>sufficient</i> to cover operating, maintenance and most investment needs in the face of extreme supply shortages	Tariff <i>sufficient</i> to cover full cost of modern water systems in most high-income cities

Source: Foster and Yepes, 2005

### ***Normative Loss Rates***

In the event that country specific data are unavailable for the normative loss rate “ln”, we would suggest the use of 0.2 in the water sector.



## ***b) Energy Sector***

### ***Thresholds used for the average cost-recovery price in the power sector***

Where data are not readily available on the Average Cost Recovery Price in the power sector the following thresholds could be applied. Thresholds for the Average Cost Recovery Price in the gas sector have not been provided due to the wide variation in this parameter across countries in ECA.

<b>Residential customers</b>		<b>Industrial customers</b>
<US\$0.04/kWh	Tariff <i>insufficient</i> to cover basic operating and maintenance costs	Tariff <i>insufficient</i> to cover basic operating and maintenance costs.
>US\$0.05/kWh		Tariffs likely to be making a significant contribution towards capital costs, in most types of systems.
>US\$0.08/kWh	Tariffs likely to be making a significant contribution towards capital costs, in most types of systems.	

Source: Foster and Yepes, 2005

### ***Normative Loss Rates***

In the event that country specific data are unavailable for the normative loss rate “ln”, we would suggest the use of 0.1 (electricity) and 0.02 (gas).

## C. Tables

### Hidden Cost Calculations

#### *Calculated Hidden Costs – The Power Sector*

Country	Hidden Costs: Unaccounted Losses [US\$ million, 2001 constant]				Hidden Costs: Collection Failures [US\$ million, 2001 constant]				Hidden Costs: Tariff Below Cost Recovery [US\$ million, 2001 constant]				Hidden Costs: Total [US\$ million, 2001 constant]				Hidden Costs: Total [% GDP]			
	2000	2001	2002	2003	2000	2001	2002	2003	2000	2001	2002	2003	2000	2001	2002	2003	2000	2001	2002	2003
Albania	168	131	143	135	36	19	16	14	193	165	133	98	397	315	292	247	10.49	7.41	6.14	4.16
Armenia	9	9	11	18	16	25	12	5	3	12	0	5	28	46	23	27	1.42	2.19	0.98	1.00
Azerbaijan	53	36	27	14	243	161	189	219	320	379	283	210	616	577	498	443	11.40	10.10	8.11	6.42
Belarus	12	14	0	0	191	140	24	0	125	121	84	0	327	275	108	0	2.51	2.22	0.75	0.00
Bosnia	53	45	41	0	0	20	0	4	199	190	172	92	251	255	212	96	5.40	5.08	3.85	1.42
Bulgaria	157	120	131	133	88	95	102	74	975	889	845	521	1220	1104	1079	729	9.45	8.12	7.04	3.80
Croatia	42	65	34	59	140	139	145	187	207	205	214	8	390	409	392	253	2.07	2.06	1.75	0.91
Georgia	208	121	118	127	124	65	59	50	49	34	38	53	381	220	216	230	12.21	6.85	6.45	5.97
Kazakhstan	218	213	163	140	141	148	159	175	262	274	267	69	621	635	589	384	3.31	2.87	2.43	1.33
Kyrgyz Republic	122	283	211	83	20	9	12	29	119	93	77	57	261	385	301	169	18.64	25.23	19.02	9.16
Macedonia	10	11	19	14	25	0	0	28	149	112	114	209	184	123	132	252	5.01	3.59	3.54	5.57
Moldova	98	110	52	51	28	0	0	0	17	4	0	0	143	114	52	51	10.84	7.68	3.20	2.71
Poland	168	259	169	173	92	105	0	0	163	2228	1850	1376	423	2592	2019	1549	0.25	1.40	1.07	0.76
Romania	176	186	183	155	102	110	119	43	1162	1179	812	533	1440	1474	1114	731	3.80	3.67	2.47	1.33
Russia	976	1062	916	525	680	947	790	0	12593	8909	8874	3708	14249	10918	10579	4233	5.36	3.56	3.11	1.01
Serbia and Montenegro	254	248	113		193	128	118	221	1529	1536	1137	1290	1977	1912	1368	1744	22.45	16.52	8.86	8.70
Tajikistan	20	20	15	30	8	13	8	9	257	238	255	209	286	272	279	248	28.18	24.95	22.95	16.53
Turkey	1467	1408	954	1035	637	663	758	449	1482	991	295	0	3586	3062	2008	1484	1.76	2.11	1.11	0.64
Ukraine	377	466	449	368	391	285	218	147	2139	1838	1656	1413	2907	2588	2323	1928	9.08	6.81	5.56	4.03
Uzbekistan	15	0	2	219	71	80	171	139	1119	1079	1077	802	1205	1159	1251	1159	8.55	10.16	13.11	12.05
Total	4604	4805	3753	3280	3227	3153	2900	1793	23062	20477	18184	10652	30892	28436	24836	15958				
Total CEE	168	259	169	173	92	105	0	0	163	2228	1850	1376	423	2592	2019	1549				
Total SEE	2327	2213	1618	1531	1222	1174	1258	1021	5897	5268	3722	2751	9446	8655	6597	5535				
Total FSU-LI	525	579	437	543	511	354	452	450	1884	1839	1731	1336	2919	2771	2620	2329				
Total FSU-MI	1583	1755	1528	1033	1403	1520	1190	322	15119	11142	10881	5189	18104	14417	13600	6545				

*Calculated Hidden Costs – The Natural Gas Sector*

Country	Hidden Costs: Unaccounted Losses [US\$ million, 2001 constant]				Hidden Costs: Collection Failures [US\$ million, 2001 constant]				Hidden Costs: Tariff Below Cost Recovery [US\$ million, 2001 constant]				Hidden Costs: Total [US\$ million, 2001 constant]				Hidden Costs: Total [% GDP]			
	2000	2001	2002	2003	2000	2001	2002	2003	2000	2001	2002	2003	2000	2001	2002	2003	2000	2001	2002	2003
Armenia			0	13	7	4	3	0	0	0	0	0	7	4	4	13	0.38	0.19	0.15	0.48
Azerbaijan	4	1	2	3	64	51	38	43	8	16	27	16	76	68	67	62	1.40	1.19	1.09	0.89
Belarus	2	1	2	1	72	72	0	0	175	174	180	77	250	247	182	78	1.92	1.99	1.29	0.46
Bulgaria	1	8	3	7	23	22	19	16	153	113	85	173	177	144	107	195	1.37	1.06	0.70	1.01
Croatia	3	6	2	2	0	22	24			3	0	0	3	31	26	2	0.02	0.16	0.11	0.01
Georgia		19	1		25	43	41		5	0	0	0	30	62	42	0	0.95	1.95	1.24	0.00
Kazakhstan												191				191				0.66
Kyrgyz Republic					2	1	0	0	3	2	6	0	6	3	6	0	0.41	0.20	0.40	0.00
Moldova	1	1	0		9	9	9	15	0	0	3	2	10	9	12	17	0.77	0.63	0.76	0.91
Poland	55	42	43		164	214	207		535	53	22	39	755	309	272	39	0.44	0.17	0.14	0.02
Romania	2	8			143	135	7	34	236	176	200	104	381	319	208	138	1.00	0.79	0.46	0.24
Russia					200	89	127		2865	2683	2348	1644	3065	2772	2475	1644	1.15	0.90	0.72	0.39
Tajikistan			0	3	8	8	11	0	13	12	2	2	21	20	13	5	2.04	1.92	1.14	0.39
Turkey				623	192	224	260		0	0	0	0	192	224	260	623	0.09	0.15	0.14	0.27
Ukraine	31	55			388	312	441	383	771	1566	0	113	1190	1934	441	496	3.72	5.09	1.05	1.03
Uzbekistan	9	9			116	96	145		291	277	423	125	416	383	568	125	2.95	3.36	5.93	1.29
<b>Total</b>	<b>109</b>	<b>150</b>	<b>54</b>	<b>651</b>	<b>1415</b>	<b>1303</b>	<b>1332</b>	<b>491</b>	<b>5055</b>	<b>5077</b>	<b>3298</b>	<b>2485</b>	<b>6578</b>	<b>6529</b>	<b>4684</b>	<b>3628</b>				
Total CEE	55	42	43	0	164	214	207	0	535	53	22	39	755	309	272	39				
Total SEE	7	22	5	632	358	404	310	50	388	292	285	277	753	718	601	958				
Total FSU-LI	14	30	4	19	232	212	247	58	319	308	462	145	565	549	712	222				
Total FSU-MI	33	56	2	1	660	473	568	383	3812	4423	2529	2024	4505	4953	3098	2409				

*Calculated Hidden Costs – The Water Sector*

Country	Hidden Costs: Unaccounted Losses [US\$ million, 2001 constant]				Hidden Costs: Collection Failures [US\$ million, 2001 constant]				Hidden Costs: Tariff Below Cost Recovery [US\$ million, 2001 constant]				Hidden Costs: Total [US\$ million, 2001 constant]				Hidden Costs: Total [% GDP]			
	2000	2001	2002	2003	2000	2001	2002	2003	2000	2001	2002	2003	2000	2001	2002	2003	2000	2001	2002	2003
Armenia		45	83	90		2	3	2		10	25	34		57	111	126		2.7	4.7	4.6
Azerbaijan					8	1			14	12	19		21	13	19		0.4	0.2	0.3	
Belarus	9	9			14	14			36	37			59	60			0.5	0.5		
Bulgaria	169	125	131	128	12	15	23	23	96	74	54	44	277	214	208	195	2.2	1.6	1.4	1.0
Czech Republic	49	40			30	31			8				87	71			0.2	0.1		
Estonia			76				5				22				103				1.5	
Georgia	22	26	26	26		5			36	40	37	34	58	72	62	60	1.9	2.2	1.9	1.5
Kazakhstan	32	34	45						23	23	32		55	56	77		0.3	0.3	0.3	
Kyrgyz Republic	5	4	5										5	4	5		0.4	0.3	0.3	
Latvia							30				59				89				1.0	
Moldova	18	28	28	28	5	1	3	2	25	24	23	17	48	53	53	47	3.6	3.6	3.3	2.5
Poland	247	247	288	307	11	12	13	14	122	144	167	165	394	416	468	474	0.2	0.2	0.3	0.2
Romania				208				24				365				597				1.1
Russia	63	88	208	130	613	310			770	812	296	660	1446	1209	477	791	0.5	0.4	0.1	0.2
Tajikistan					2				2	1	1		3	1	1		0.3	0.1	0.1	
Ukraine	12	28	49	64	19	58	60	52	8	30	51	64	99	45	159	179	0.1	0.3	0.4	0.4
<b>Total</b>	<b>626</b>	<b>574</b>	<b>939</b>	<b>981</b>	<b>714</b>	<b>450</b>	<b>137</b>	<b>118</b>	<b>1140</b>	<b>1206</b>	<b>785</b>	<b>1383</b>	<b>2552</b>	<b>2271</b>	<b>1832</b>	<b>2469</b>				
Total CEE	296	287	364	307	41	43	48	14	130	144	249	165	481	487	660	474				
Total SEE	169	125	131	336	12	15	23	47	96	74	54	409	277	214	208	792				
Total FSU-LI	45	103	142	144	15	10	6	4	77	87	104	85	135	200	251	233				
Total FSU-MI	116	159	302	194	646	382	60	52	837	901	378	724	1659	1370	713	970				

## **Annex 2. Data Sources, Availability, and Definitions**

The following sections outline data availability, sources, and definitions of variable by sector. The full data set supporting this paper can be accessed at <http://ecadata-worldbank.org>.

### **The Energy Sector**

In the energy (power and natural gas) sector data have proved to be generally available for twenty-two countries in the ECA Region through external data sets particularly where these data relate to energy production, consumption, import, export, and loss statistics and to a slightly lesser degree tariffs. Loss statistics have been generally available in the power sector but have been patchy at best for the natural gas sector.

Key data sets accessed include ENERDATA and ERRANET; however there have been no externally available data sets for cross-country data on normative losses, collection rates, and cost-recovery prices. For the purpose of this exercise these data have been sourced through World Bank Group sector specialists that are working in these countries. While efforts have been made to verify and assure the quality of data provided and to check for consistency and outliers in data sets, there has been no field-based data collection effort or audit in the Region.

A summary of data sources follows:

- Values for domestic energy production, imports, exports, and change in stocks—which together account for the total domestic supply—have been obtained from ENERDATA (<http://www.enerdata.fr/>) through subscription.
- Energy tariff rates have been obtained from ERRANET through subscription. (<http://www.erranet.org/Products/TariffDatabase/TariffIndex>)
- The Bank's World Development Indicators Database (2004) is the source for GDP, Exchange Rate, and Price Deflators.
- Sector specialists—based at the World Bank office in Washington, DC, or in World Bank country offices, have provided supplementary data on the energy sector, or have suggested corrections in the values reported in ENERDATA or ERRANET. Such expert data, where available, have been used to substitute primary data.

### *Data Availability*

For the analysis, countries included in the data set have been classified into groups based on a combination of geographic and economic criteria. The data set covers the four-year period 2000-03.

<b>Name</b>	<b>Acronym<sup>10</sup></b>	<b>Countries Included</b>
Central and Eastern Europe	CEE (2)	Hungary, Poland
South East Europe	SEE (8)	Albania, Bosnia, Bulgaria, Croatia, Macedonia, Romania, Serbia and Montenegro, Turkey
Former Soviet Union – Low Income Countries	FSU-LI (8)	Armenia, Azerbaijan, Georgia, Moldova, Kyrgyz Republic, Tajikistan, Turkmenistan, Uzbekistan
Former Soviet Union – Middle Income Countries	FSU-MI (4)	Belarus, Kazakhstan, Russia, Ukraine

### *Description of Variables*

<b>Indicator</b>	<b>Unit</b>	<b>Definition</b>
Average Cost Recovery Price (ACRP)	US\$/ kWh (power) US\$ per 1000 m3 or US\$ per mcm (gas)	Average cost-recovery price at the end-user level defined as long run operations and maintenance costs plus allowance for reasonable investment and normative losses.
Collection Rate	rate (as a proportion of billed consumption)	This is the proportion of the billed charges to consumers of the respective energy that is actually collected in some form by the utility/service provider.
End-User Consumption	kWh metered or otherwise observed (power)  thousand m3 (mcm) metered or otherwise observed (gas)	End-user consumption measures the needs of the final consumers of the country. They are broken down into several categories: industry, transport, residential, tertiary, agriculture and non-energetic uses. This measure is the actual final consumption that is marketed by the utilities, which is the difference between domestic consumption and the consumption that results from the transformation process, and the losses involved, for each country. In ENERDATA tables, the values correspond to Total Final Consumption.
Normative Loss	Rate, as a proportion of power injected into transmission  Rate, as a proportion of gas produced for transport	Normative losses are that component of total losses that accrue due to system design and technology constraints; they are inevitable and predictable.
Total Loss	Rate, as a proportion of power injected into transmission  Rate, as a proportion of gas produced for transport	Rate of actual losses in transmission and distribution due to technical issues and due to theft. ENERDATA is the primary source for transmission and distribution losses, supplemented with data from sector specialists where available.
WAET	USc/ kWh (power)  US\$/ 1000 m3 or US\$ per mcm (gas)	Weighted average end-user tariff.

<sup>10</sup> Number of counties shown in parentheses.

## The Water Sector

The water sector review draws primarily upon data from utility surveys carried out by the Organization for Economic Cooperation and Development (OECD) and East Asia Pacific Region (EAP) Task Force in 2001-03 and now available through IB-NET. The original OECD country data sets are based on samples from utilities across the country, and the approach that has been taken by the OECD has been to multiply per capita averages for the sample by the urban population to arrive at a national average.

IB-NET otherwise known as the International Benchmarking Network for Water and Sanitation Utilities collects standard utilities performance indicators. The objective of IB-NET is to support access to comparative information that will help promote best practice among water supply and sanitation providers worldwide and eventually will provide consumers with access to high quality, and affordable water supply and sanitation services.

IB-NET sets forth a common set of data definitions and a minimum set of core indicators which, with some modifications and supplements from data sources from secondary sources, have been used for estimating hidden costs and presenting a picture of technical and financial performance of the water sector. The IBNET website is <http://www.ib-net.org/>.

A summary of data sources follows:

- Armenia, Azerbaijan, Georgia, Kazakhstan, Kyrgyz Republic, Moldova, Russian Federation, Tajikistan (all 2001-2003) and Ukraine (2000-2001) use data collected by the OECD EAP Task Force (now available through: [www.ib-net.org](http://www.ib-net.org/)).
- Albanian data have been sourced from the National Water Association report, 2003.
- Data for Danube basin countries (Czech Republic, Hungary, Serbia and Montenegro, Romania, Slovak Republic, Croatia, Bulgaria, and Bosnia Herzegovina) have been sourced from UNDP/GEF (2004).
- Data for European Union accession countries have been sourced through ISPA reports (2000-2004).
- Data for Belarus have been sourced through the State of Environment report, Ministry of Environment, 2003.
- Data for Poland (2000-03) and Ukraine (2002-03) have been sourced through national experts on the basis of reports from national municipal water authorities.
- The Bank's World Development Indicators Database (2004) is the source for GDP, Exchange Rate, and Price Deflators.
- Data from various environmental and water sector reports have been used to supplement primary data.

### *Data Availability*

Data have been collated for sixteen countries<sup>11</sup> that have been classified into groups based on a combination of geographic and economic criteria. The data set covers the four-year period 2000-03, but in

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<sup>11</sup> For the analysis of hidden costs, 11 of the 16 countries have data available for 3-4 years.

some cases the analysis is presented for the year 2002 because data are available for most countries and because there have not been significant changes in the trend across this four-year period.

Name	Acronym <sup>12</sup>	Countries Included
Central and Eastern Europe	CEE (4)	Czech Republic, Estonia, Latvia, Poland
South East Europe	SEE (2)	Bulgaria, Romania
Former Soviet Union Low Income Countries	FSU-LI (6)	Armenia, Azerbaijan, Georgia, Moldova, Kyrgyz Republic, Tajikistan
Former Soviet Union – Middle Income Countries	FSU-MI (4)	Belarus, Kazakhstan, Russia, Ukraine

### *Description of Variables*

Indicator	Unit	Definition
Average Cost Recovery Price (ACRP)	US\$/m <sup>3</sup>	The cost of 24 hours of water supply, where costs include operation, maintenance and necessary investments (equivalent to 4.0 percent of the value of utility assets per year) <sup>13</sup> .
Collection Rate	rate (as a proportion of billed consumption)	This is the proportion of the billed charges to consumers of the respective energy that is actually collected in some form by the utility/service provider.
Continuity of Service	hr/day	Average hours of water service per day.
Cost of Assets	US\$/capita	Total annual net fixed assets per (water) capita served
End User Consumption	m <sup>3</sup>	This measure is the actual final consumption that is marketed by the utilities.
Investment	US\$	Total annual investments per (water).
Labor Costs	US\$	Total annual utility reported labor costs (including benefits).
Net Fixed Assets	US\$	Total annual net fixed assets per (water).
Pipe Breaks	breaks/km/yr	Total number of pipe breaks per year expressed per km of the water distribution network.
Population Served	-	Population within the administrative area of the water utility and connected to the services.
Total Revenues	%	Total annual operating revenues per population served expressed as a percentage of the GDP per capita.
Unaccounted-for-Water	m <sup>3</sup> /km/d	Difference between water supplied and water sold as volume of water “lost” per km of water distribution network per day.
WAET	US\$/m <sup>3</sup>	Weighted Average End-user Tariff, calculated by dividing the total annual operating revenues by the annual volume of water sold.
Water Coverage	%	Percentage of the population with easy access to water services (either with direct service connection or within 200m of a stand-post) divided by the total population under the utility’s nominal responsibility.
Working Ratio	-	Total annual operational costs divided by the total annual operating revenues.

Source: World Bank, Benchmarking Water & Sanitation Utilities: A Start-Up Kit, 1999:

[http://www.worldbank.org/html/fpd/water/topics/bench/bench\\_network\\_indicatordef.html](http://www.worldbank.org/html/fpd/water/topics/bench/bench_network_indicatordef.html)

Average Cost Recovery Price – internal definition.

<sup>12</sup> Number of counties shown in parentheses.

<sup>13</sup> Adjusted to constant 2001 US dollars